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MOLDED FLUOROCARBON POLYMER PRODUCT AND METHOD OF PREPARING SAME

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This invention relates to a process of producing fluorocarbon polymer molded products from aqueous dispersions of fluorocarbon polymers and resulting products.

Various fluorocarbon polymers have outstanding electrical and heat insulation properties and have become widely adopted for many uses based on these properties. Such polymers include polyvinyl fluoride, polytetrafluoroethylene, polymonochlorotrifluoroethylene, copolymer of hexafluoropropene and vinylidene fluoride, copolymers of tetrafluoroethylene with other fluorinated ethylenically unsaturated monomers, such as, e.g., hexafluoropropene, vinyl fluoride and vinylidene fluoride. Particles of these polymers do not readily adhere to themselves due to their unctuous character. Polytetrafluoroethylene is the most widely used polymer where maximum heat and electrical insulation and chemical resistance are required.

Molded products made from these polymers have to-date been produced by subjecting dry particles to high temperatures and pressures simultaneously. In the case of polytetrafluoroethylene temperatures in excess of 621° F. and pressures in excess of 1000 p.s.i. are required to make molded products.

Prior art techniques of molding the fluorocarbon resins which involve high pressures result in a dense non-porous product.

The polymerization of fluorocarbon compounds is normally carried out in an aqueous medium and to form molding powders from the polymers requires separating the polymer from the aqueous polymerizing medium.

An object of this invention is the provision of a process of molding fluorocarbon polymers into porous shaped products at atmospheric pressure. A further object is the provision of a process of preparing molded porous shaped products directly from aqueous dispersions of fluorocarbon polymers without separating the polymer from the aqueous medium prior to shaping the molding composition into its final form. Another object of the invention comprehends filled, non-porous, molded fluorocarbon polymer shaped products produced at atmospheric pressure.

The foregoing objectives are accomplished by incorporating into an aqueous dispersion of a fluorocarbon polymer a hydraulic cement material which is capable of setting to a rigid form at substantially room temperature and without evaporating any appreciable amount of water, allowing the composition to set or convert from a liquid or paste to the solid state at substantially room temperature and atmospheric pressure. The most preferred embodiment of the invention involves the additional steps of heating the solid material to remove any uncombined water, fuse the fluorocarbon polymer into a self-supporting structure and extracting the inorganic component from the solid shaped article to produce a porous shaped product of the fluorocarbon polymer.

Throughout the specification and claims, the terms "setting," "to set" or "set" are used to denote the conversion of the molding composition from the liquid or semi-liquid state to the solid state.

By the term "hydraulic cement" is meant any inorganic material that hardens when combined with water, such as, e.g., plaster of Paris, Portland cement and Sorel cement (magnesium oxychloride, $3MgO \cdot MgCl_2 \cdot 11H_2O$).

The following specific examples are given by way of illustration and not limitation wherein all parts and percentage figures are expressed on a weight basis unless stated otherwise.

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Example I

A high temperature and chemical resistant filter was made by first preparing the following composition:

	Parts by weight	
Aqueous dispersion of polytetrafluoroethylene:		
Polytetrafluoroethylene	60.0	62.5
Water	36.4	
"Triton 100" (octyl phenyl polyglycol ether)	3.6	
Powdered plaster of Paris, $(Ca_2SO_4)_2 \cdot H_2O$		37.5
		100.0

The above composition was thoroughly mixed and poured into an open flat mold to a thickness of 80 mils. The composition was allowed to stand overnight at room temperature after which the composition was set to a rigid flat sheet. The sheet was removed from the mold and uncombined water was removed by drying for 3 hours at 220° F. The dried sheet was heated an additional 3 hours at 550° F., followed by a final heating for 30 minutes at 700° F. to fuse or sinter the polytetrafluoroethylene particles distributed throughout the set plaster of Paris. The product at this stage was 80 mils thick, rigid and porous. It is useful as a heat and chemical resistant filter.

The rigid product at this stage is also useful as a relatively low load rigid bearing surface due to the lubricity afforded by the fused polytetrafluoroethylene.

The rigid product can be rendered flexible by soaking it in toluene until the product is thoroughly wetted throughout and then gently flexed throughout its area to break up the plaster of Paris matrix for the fused polytetrafluoroethylene structure.

Example II

An electrical insulation material having a low dielectric constant and low dissipation factor useful in high frequency electrical circuits was made from the fused rigid sheet material of Example I by immersing it for 48 hours in the following composition maintained at its boiling temperature:

	Parts by weight
Water	72.3
Tetra sodium salt of ethylene diamine tetracetic acid	27.2
Duponol C (sodium lauryl sulfate)	.5
	100.0

The plaster of Paris was solubilized and extracted from the rigid sheet during the 48 hour immersion in the above composition maintained at its boiling temperature. After removal from the above composition, the sheet was thoroughly washed with water to remove occluded solubilized material. After drying, the sheet was porous and compressible. It consisted entirely of polytetrafluoroethylene and had the following physical properties:

Dielectric constant at 1 megacycle	1.3
Dissipation factor	0.0008
Density	0.8
Thickness (mils)	80.0
Tensile strength (p.s.i.)	192.0

Example III

A shaped filter element useful for filtering fine parti-